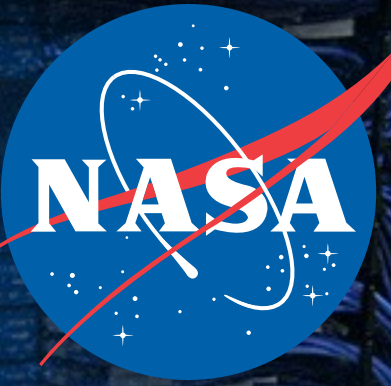


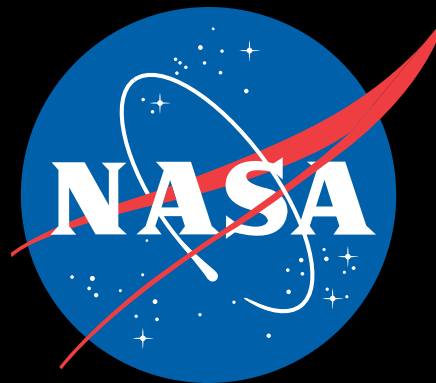
National Aeronautics and Space Administration



Simulating Atmospheric Impacts: From Pebble- to Mountain-Size Meteoroids

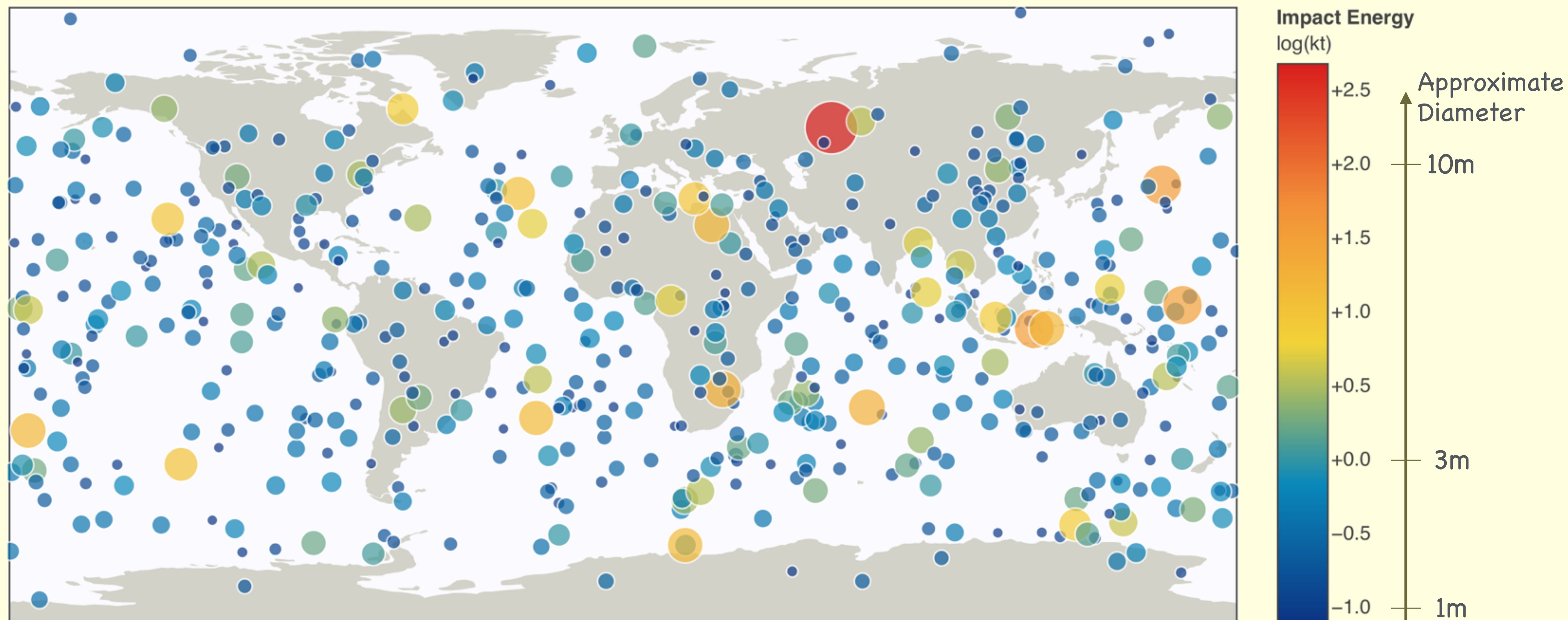
Marian Nemec
NASA Ames Research Center

SC17, Denver, CO
November 13-16, 2017



Fireballs Reported by US Government Sensors

(1988-Apr-15 to 2017-Oct-26)

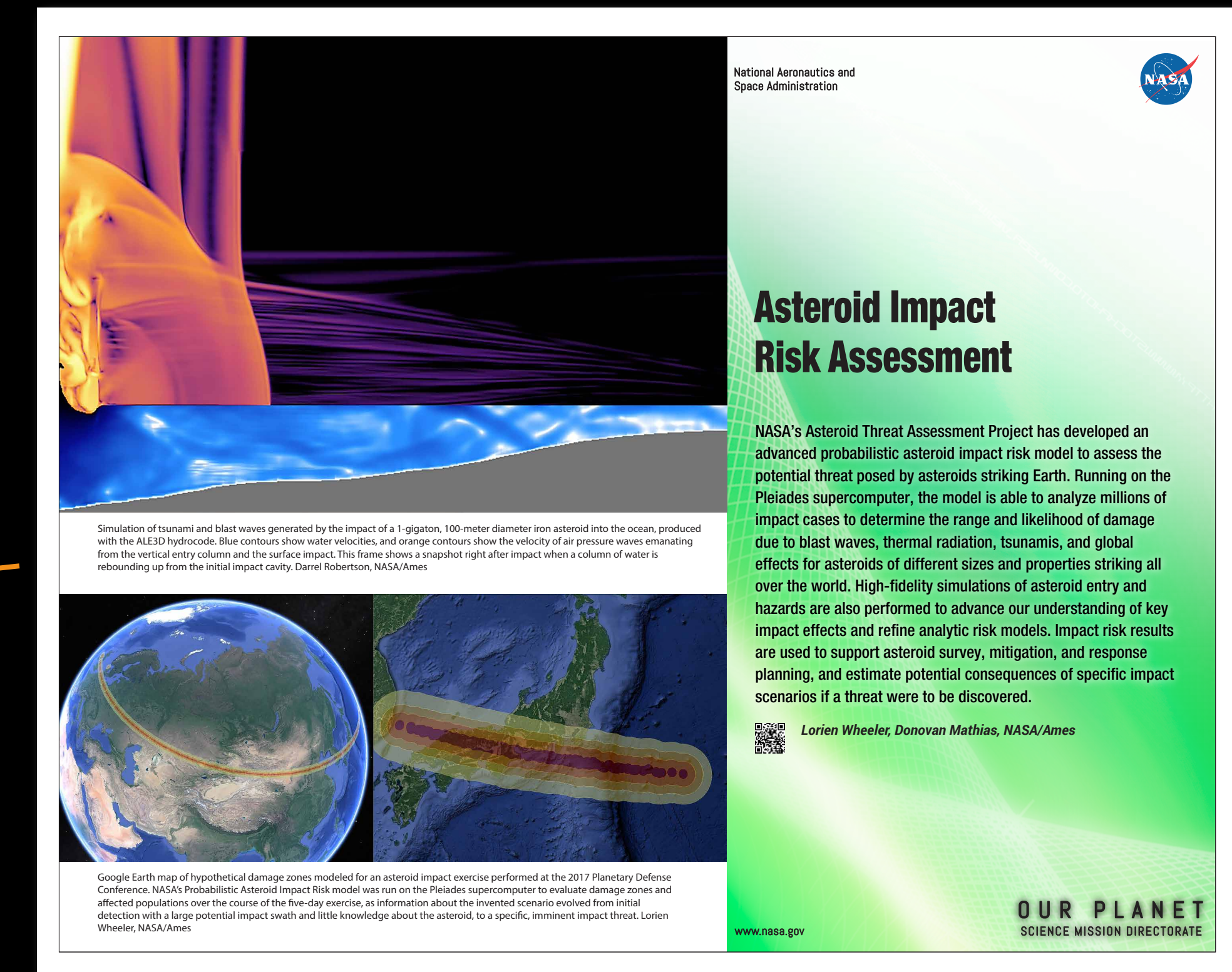
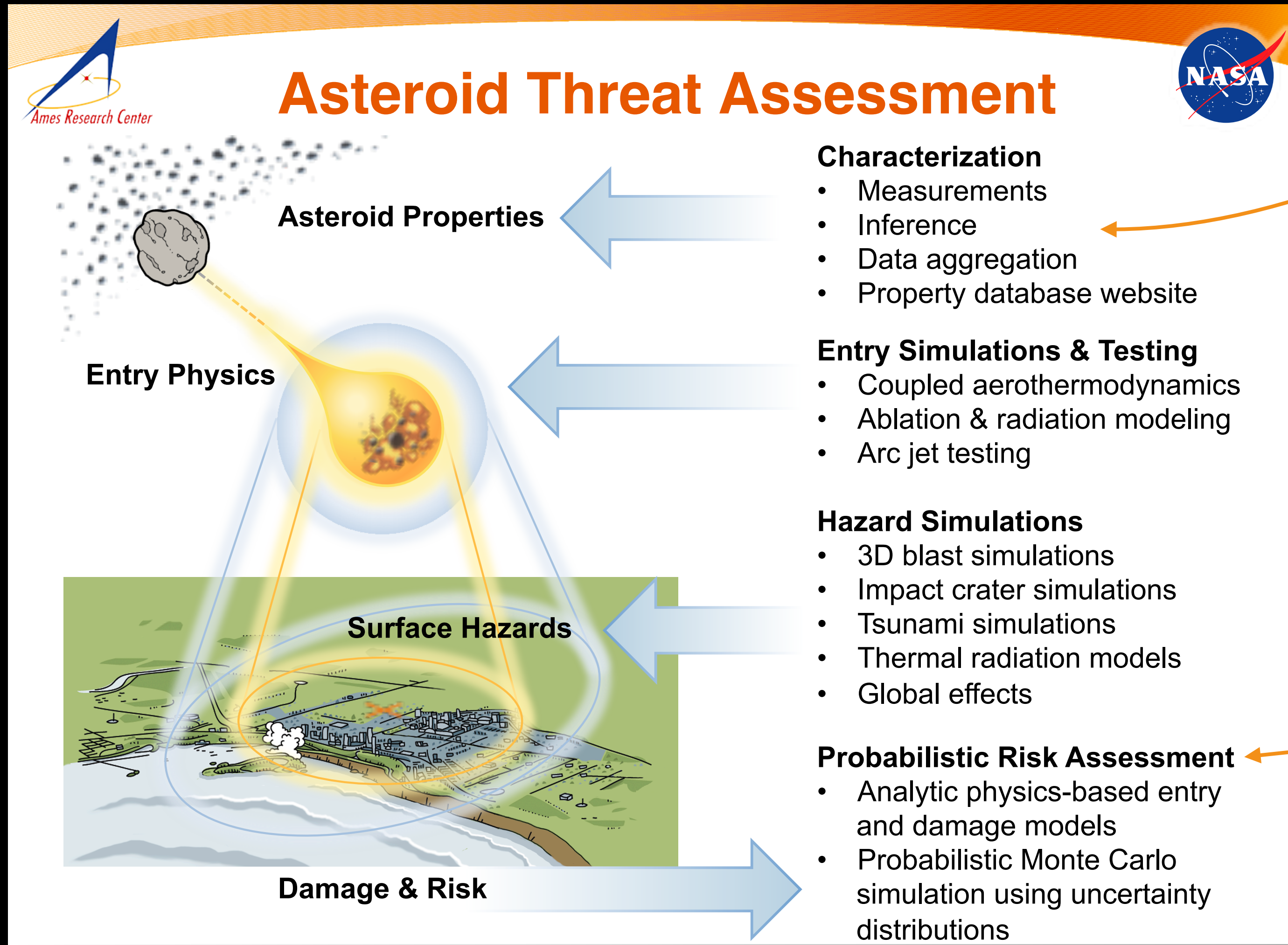
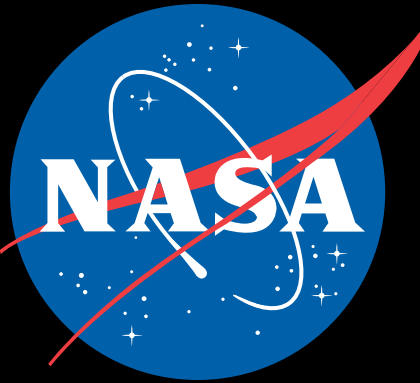


<https://cneos.jpl.nasa.gov/fireballs/>

Alan B. Chamberlin (JPL/Caltech)

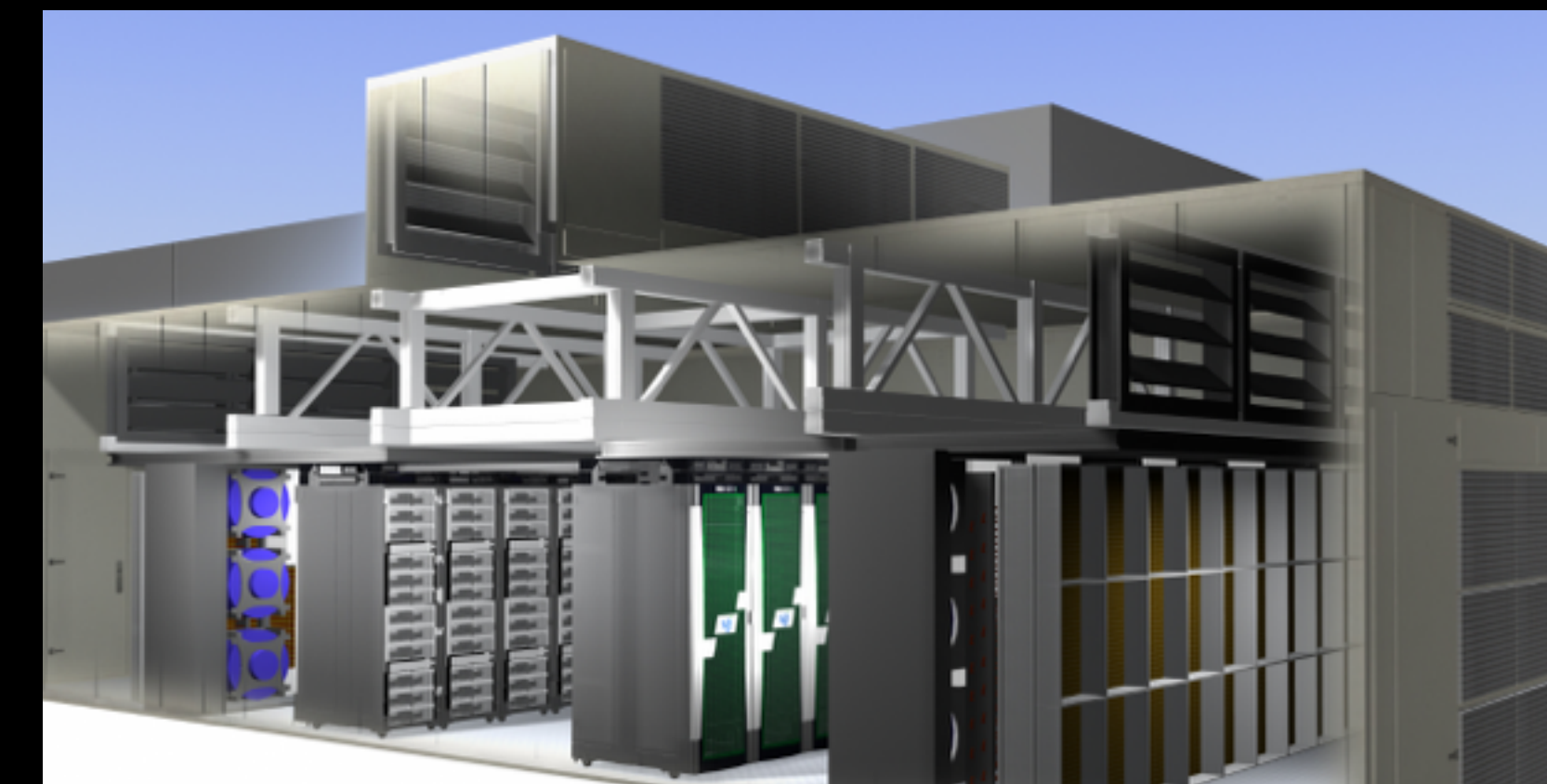
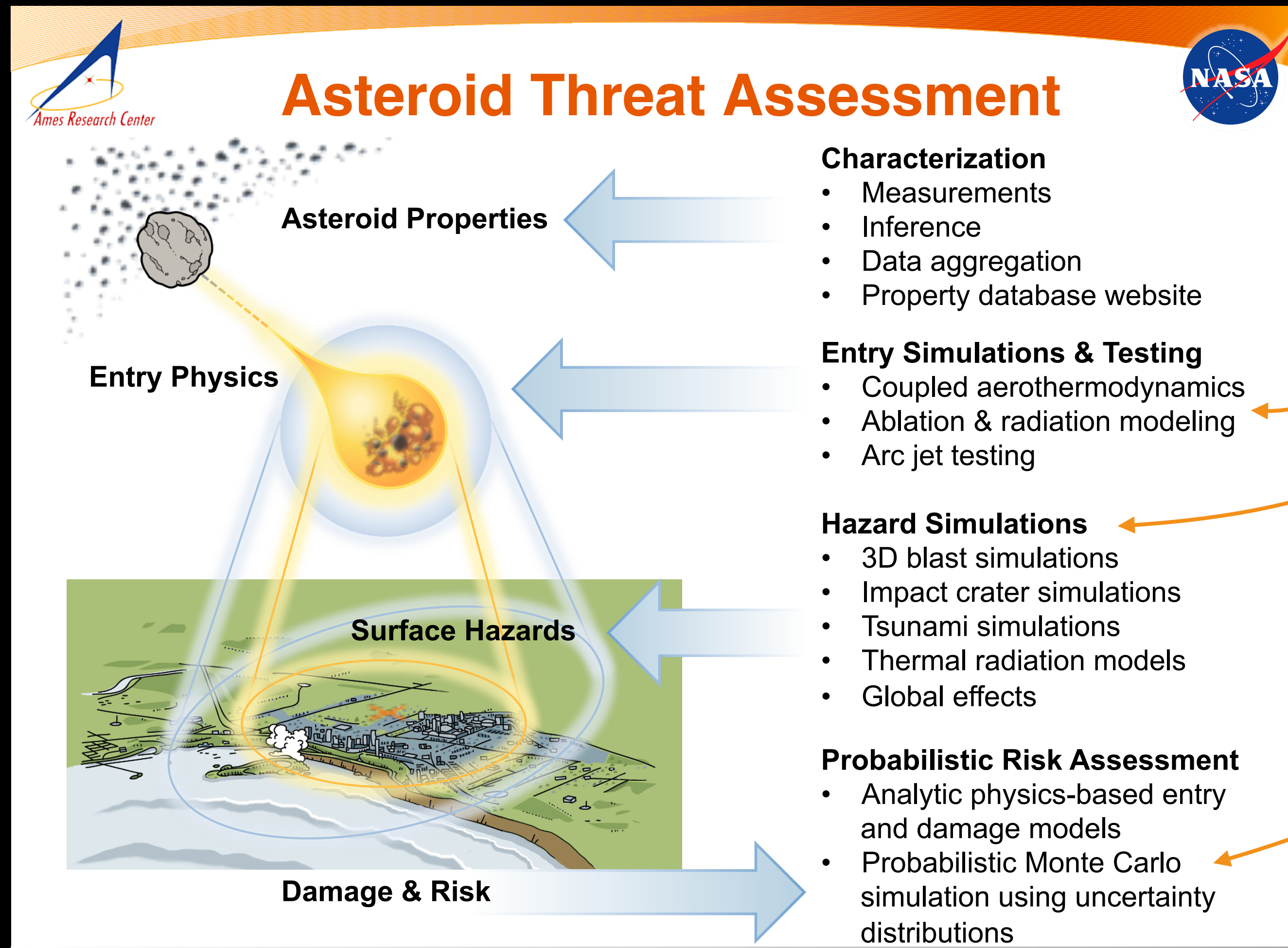
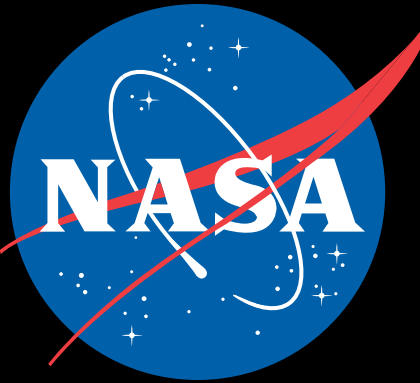
Meteoroid flux: ~50 tonnes each day (primarily sand-grain to centimeter-size bodies)

ATAP Overview



“Asteroid Threat Assessment Project” presentation to Small Bolide Assessment Group

ATAP Supercomputing



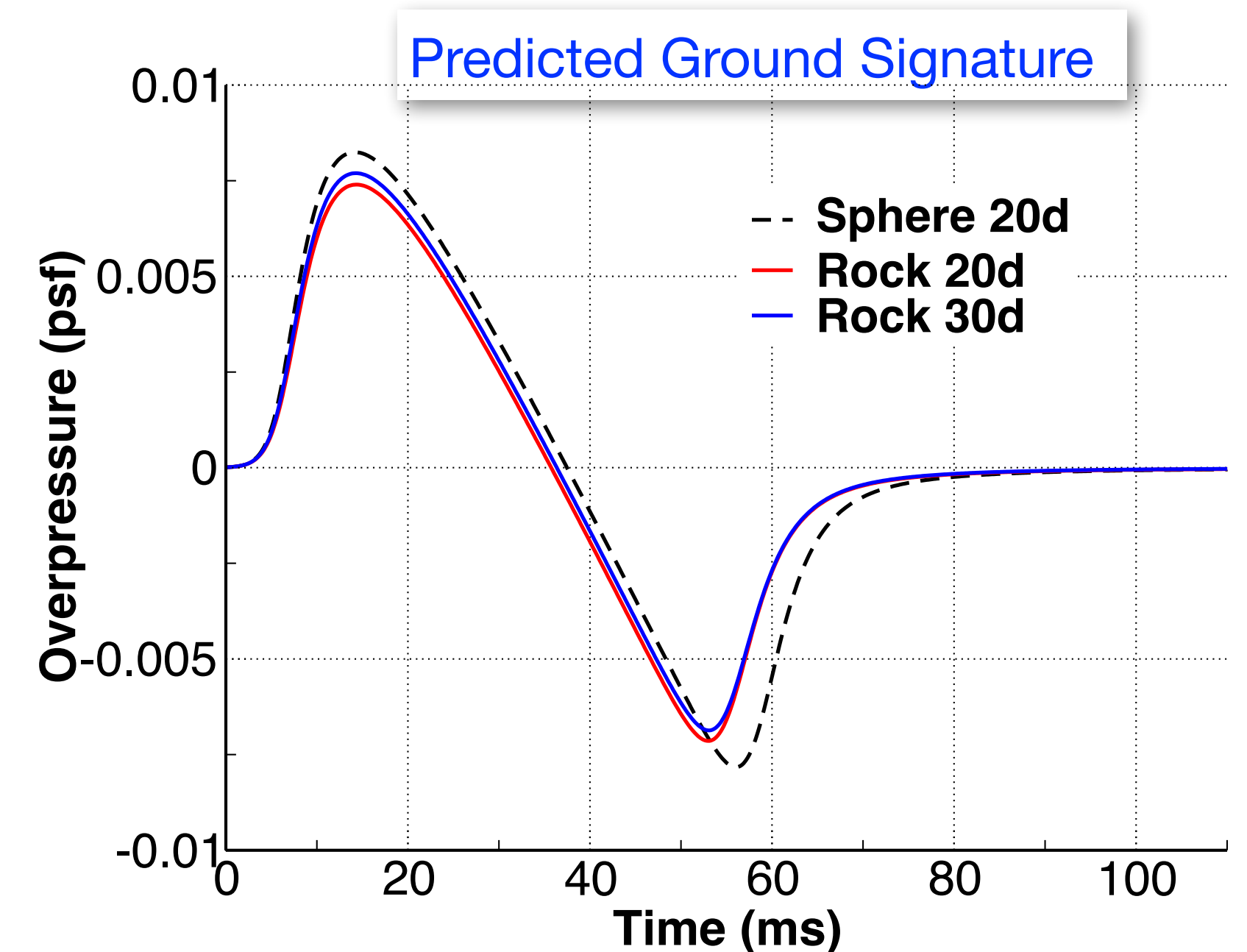
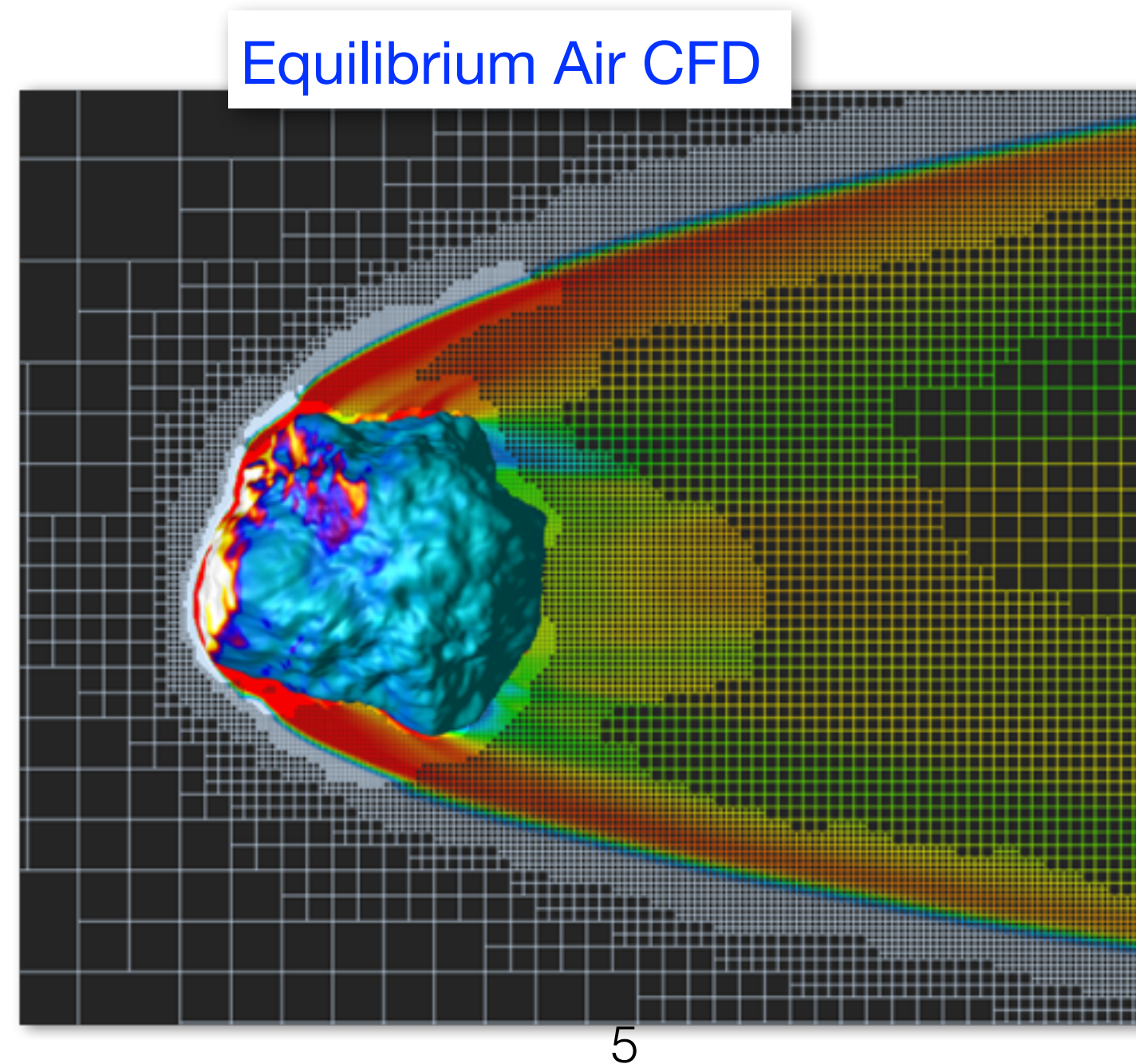
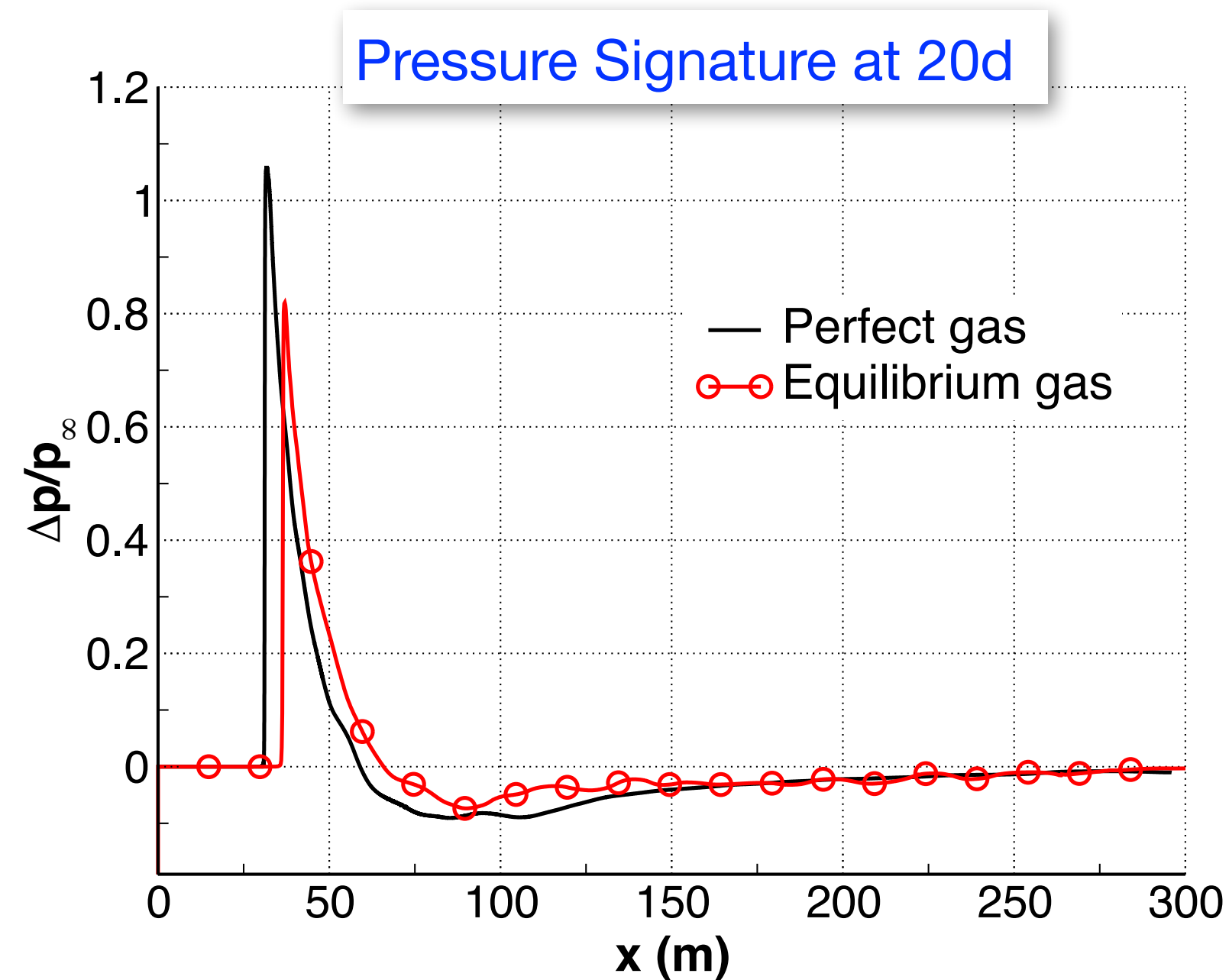
“Asteroid Threat Assessment Project” presentation to Small Bolide Assessment Group

Propagation and Overpressure Prediction

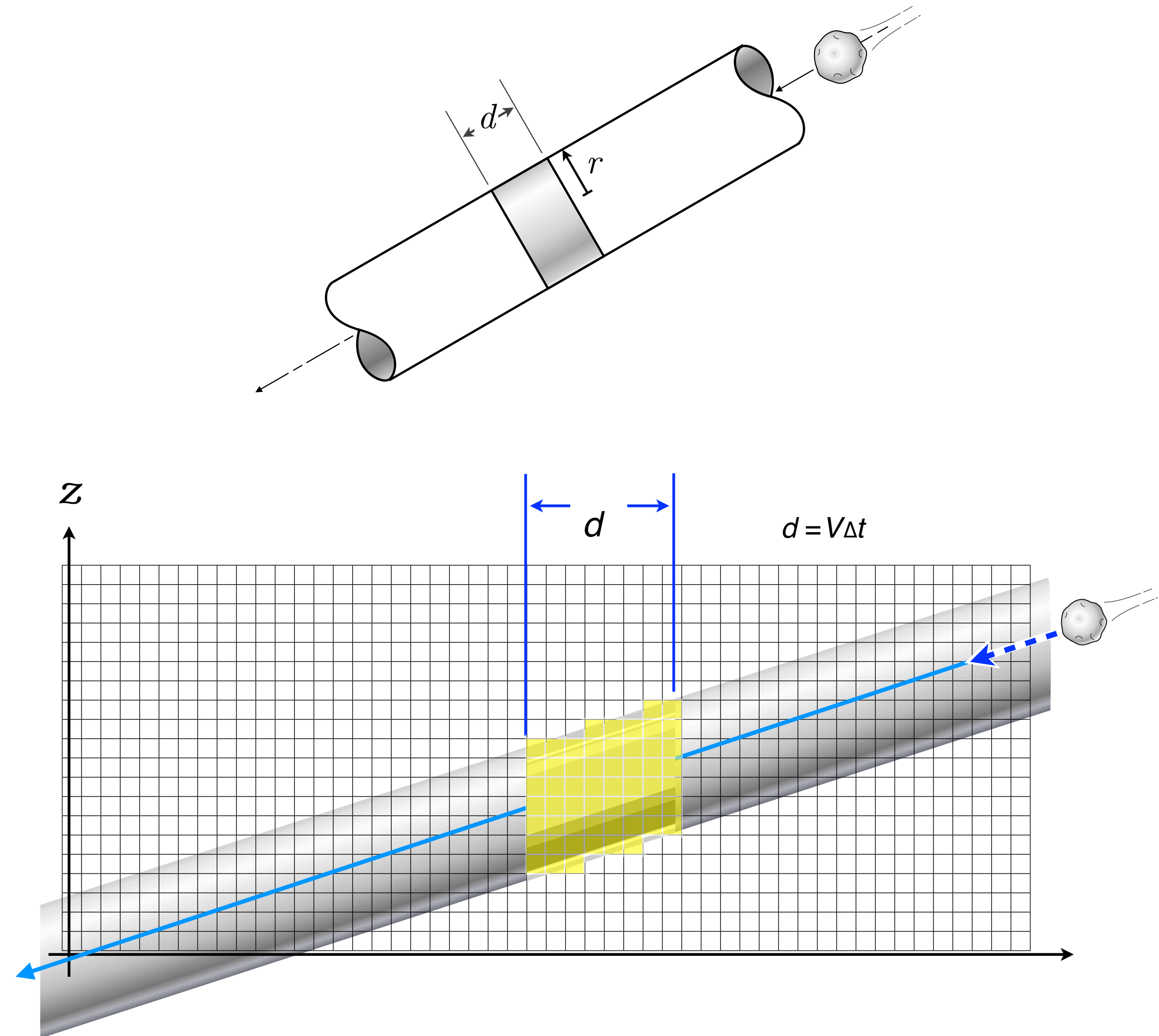
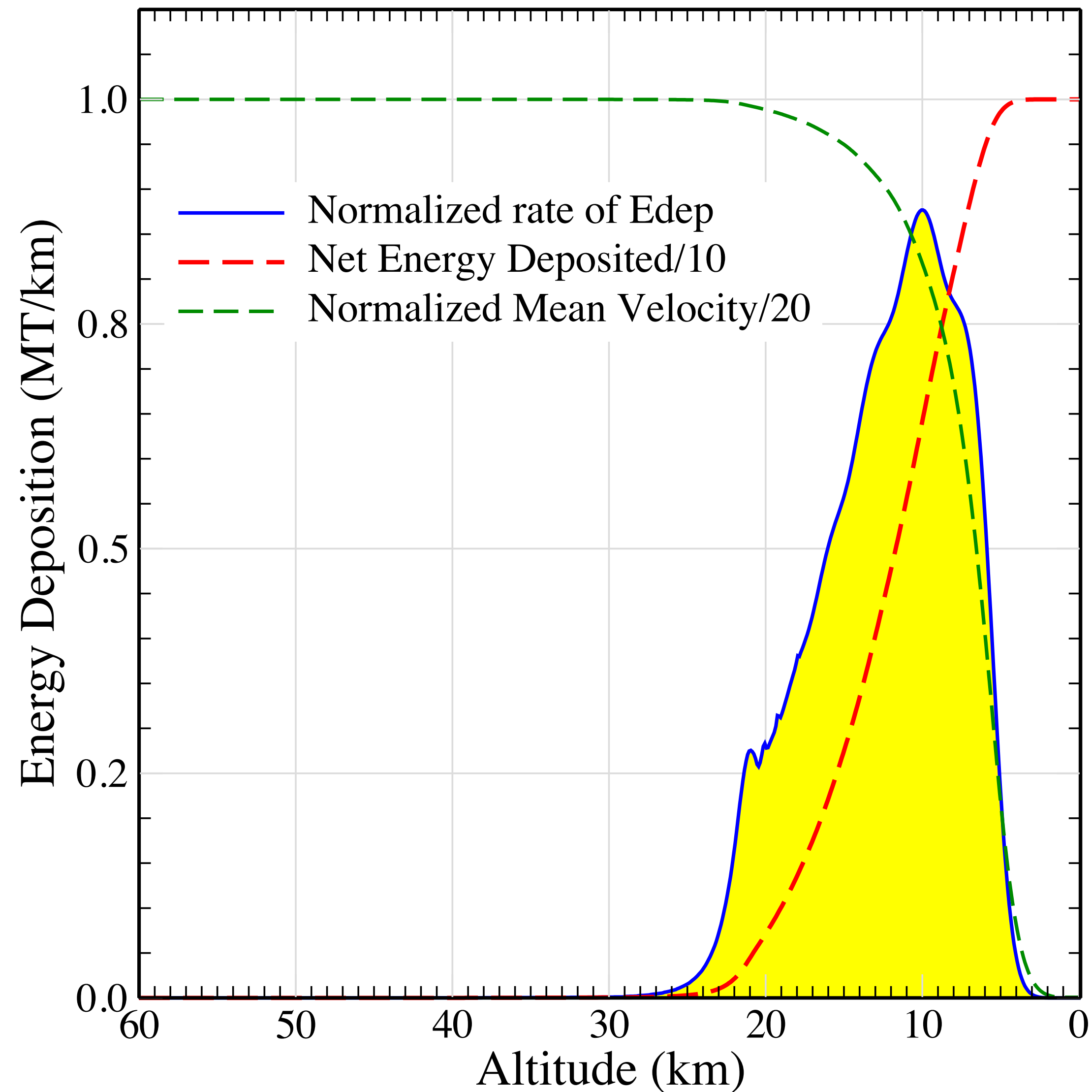
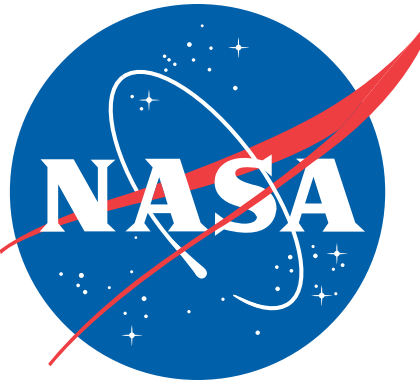


ATAP - Prediction of meteor-generated sonic boom

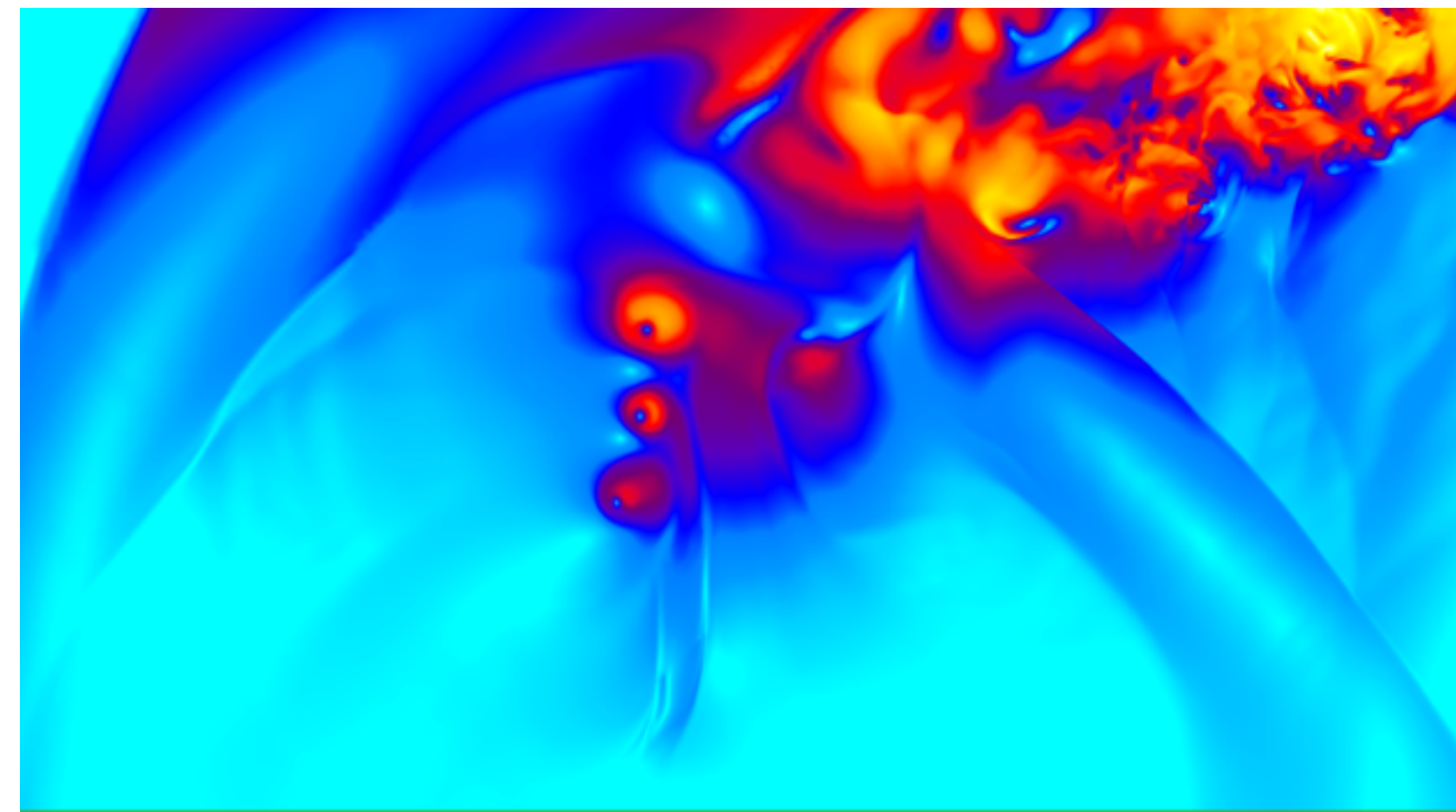
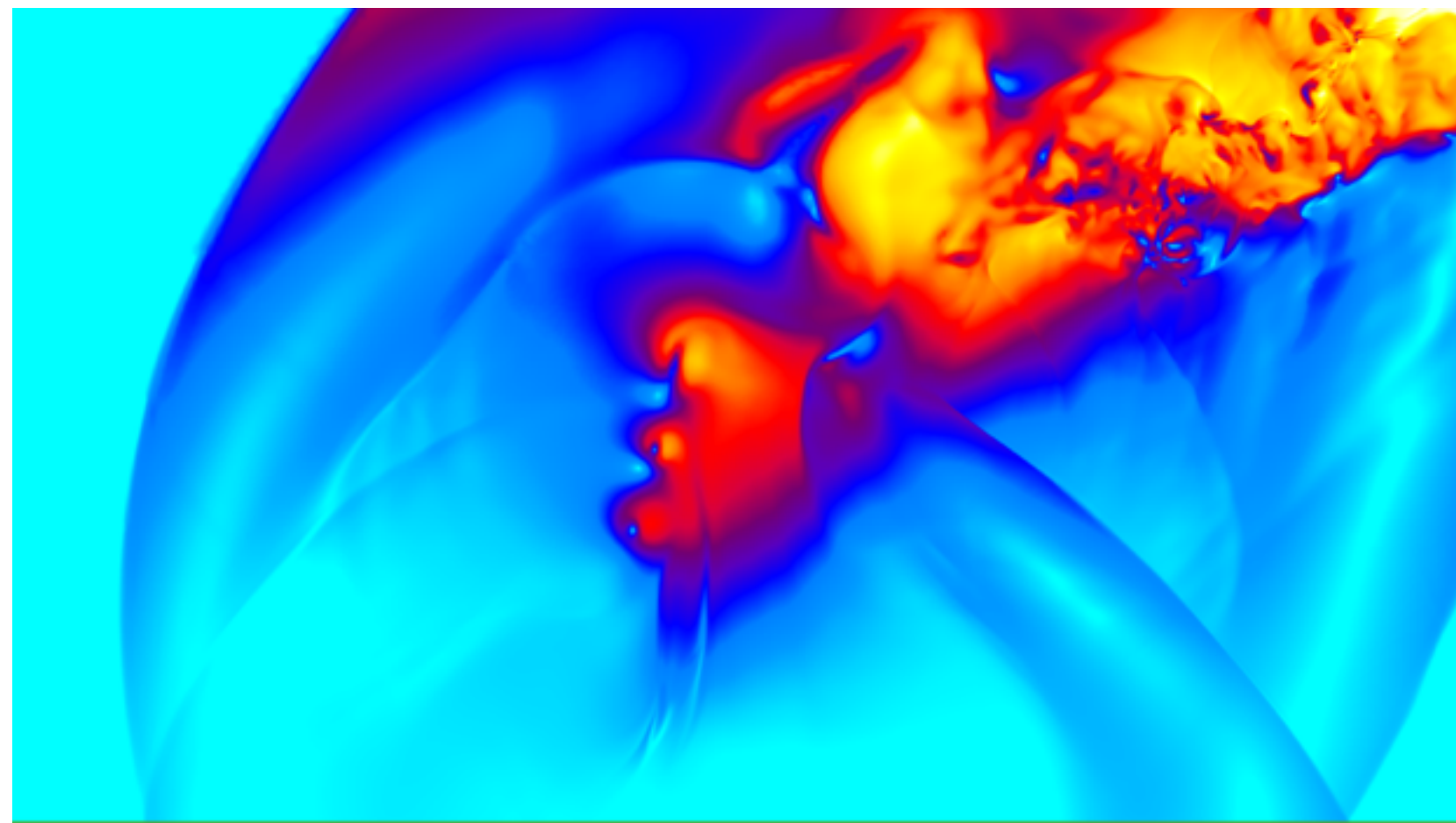
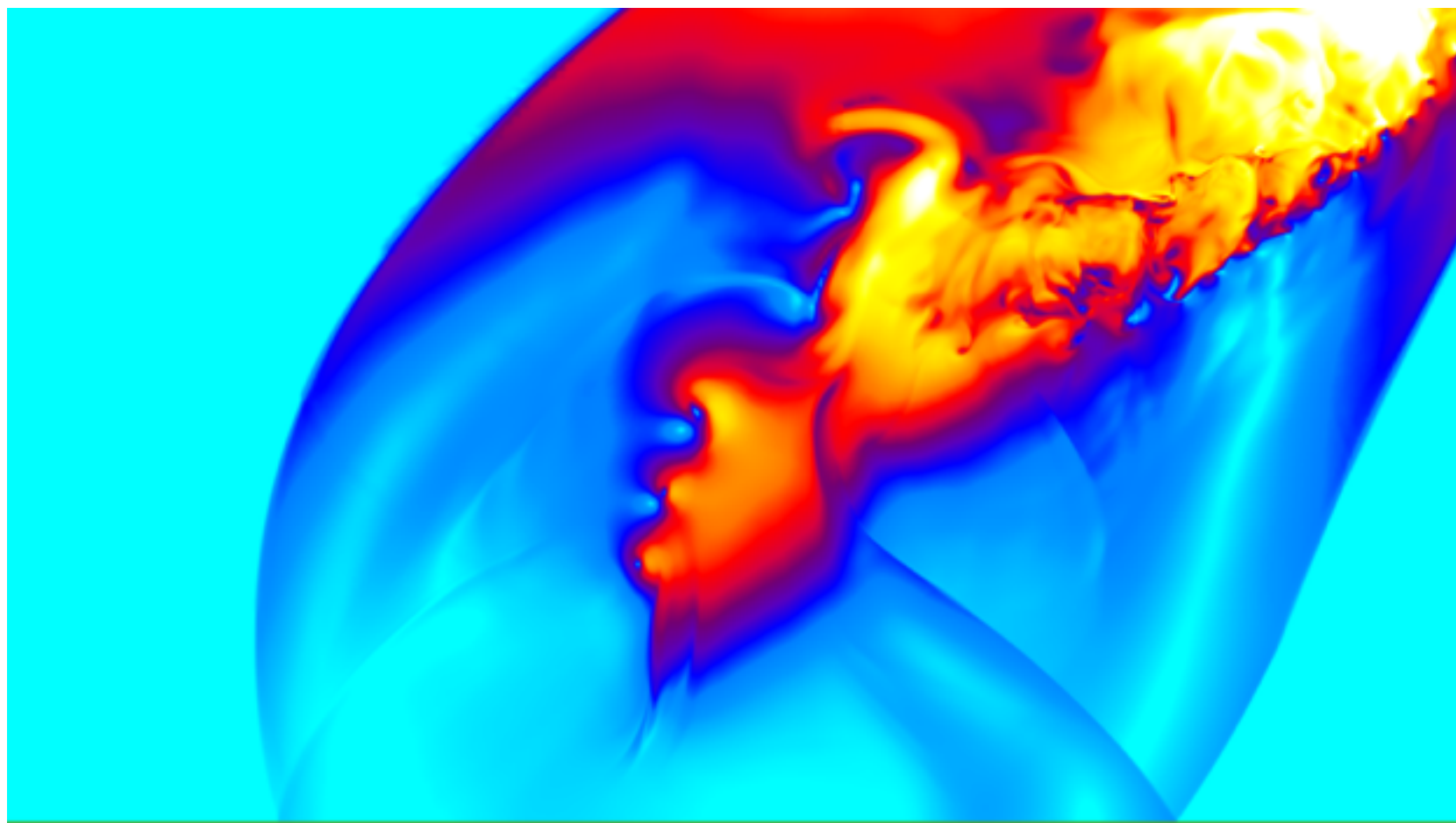
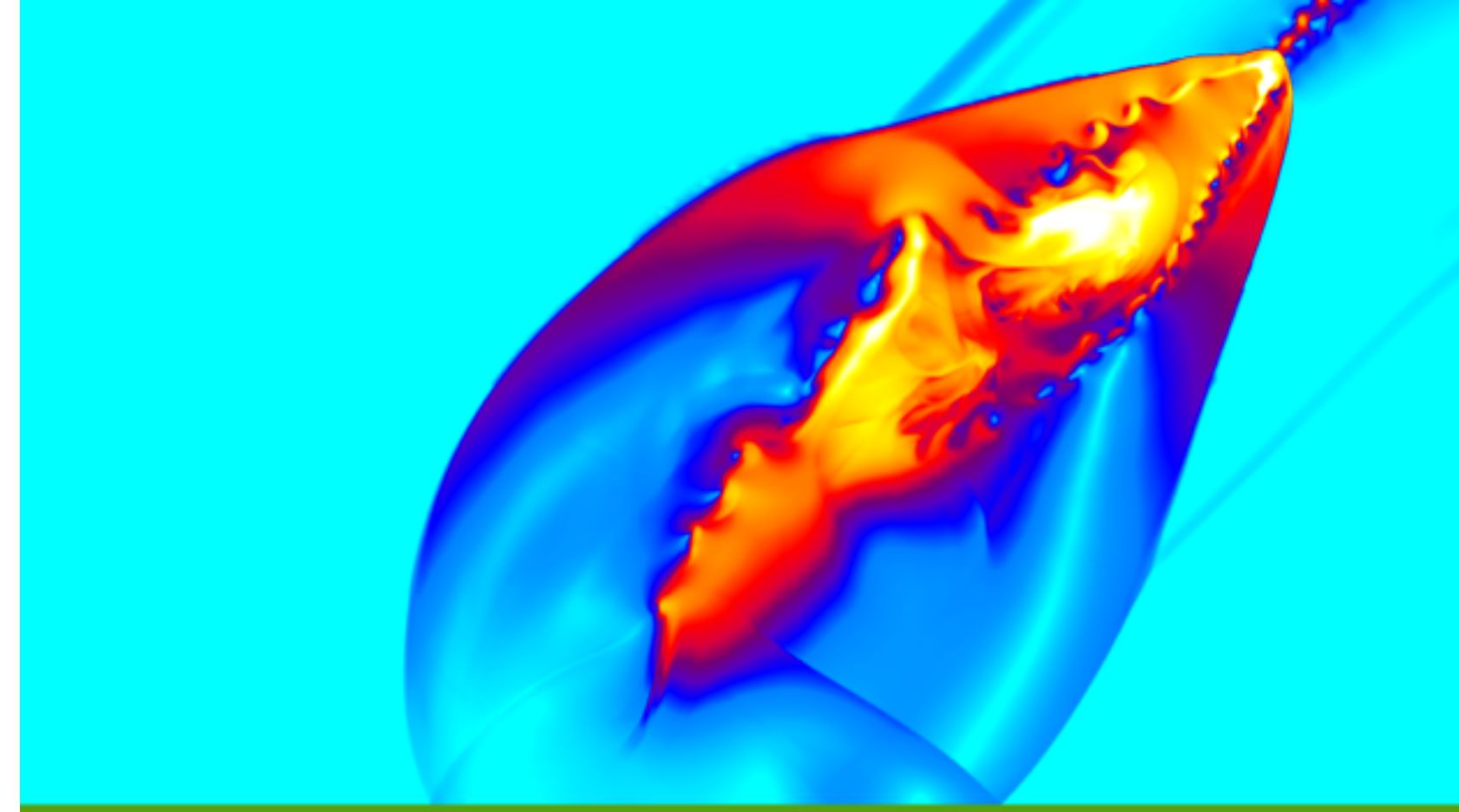
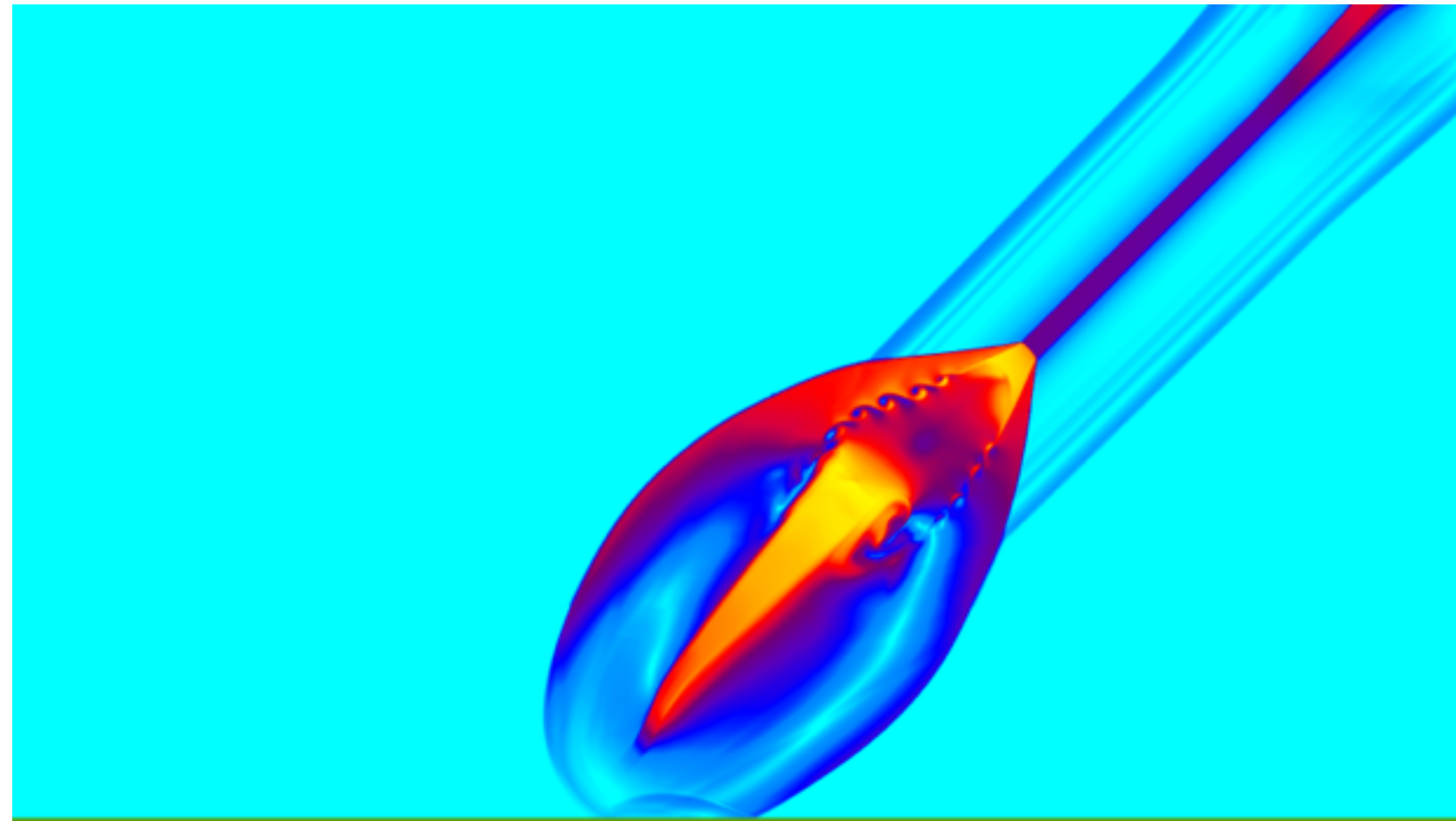
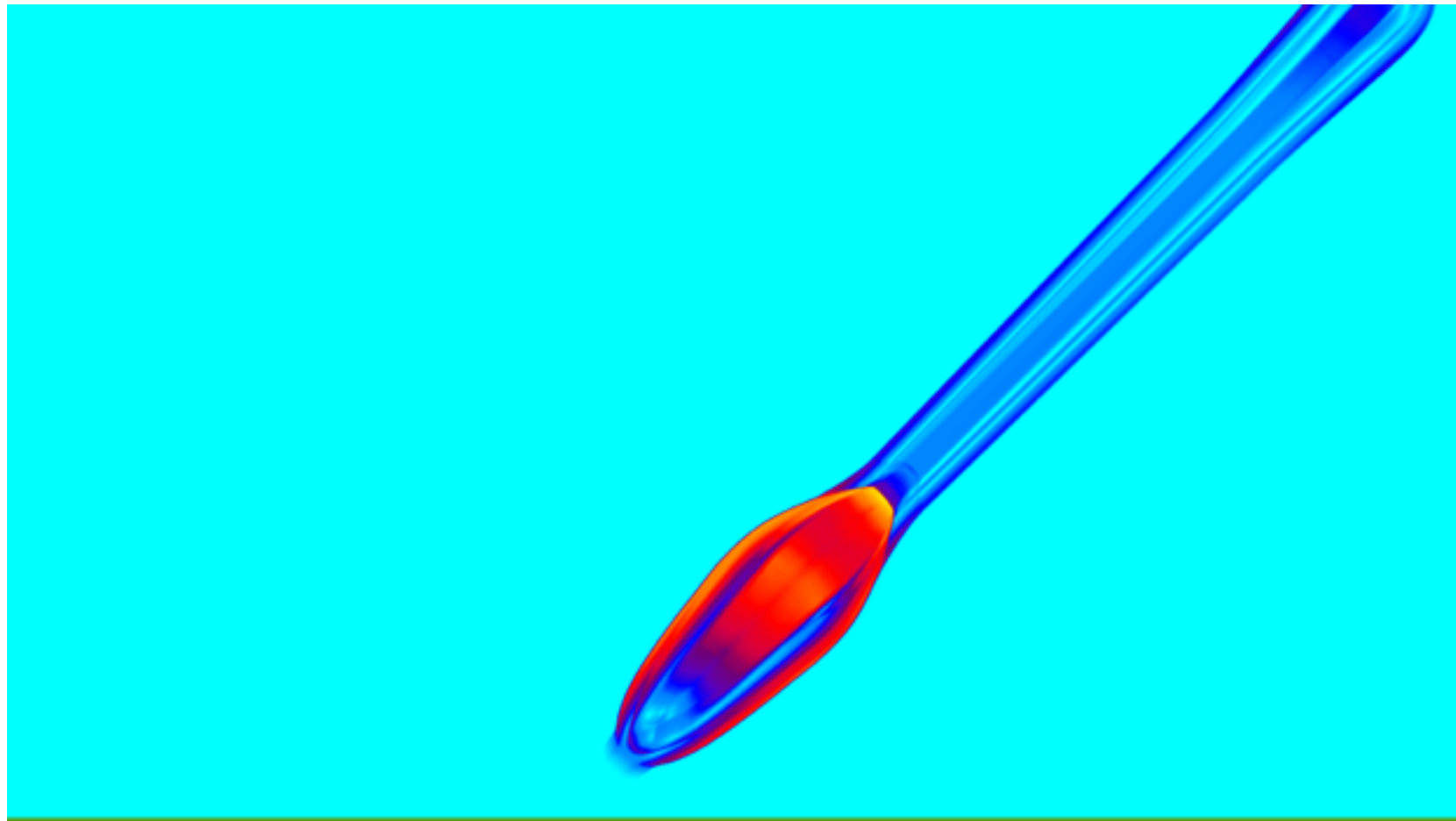
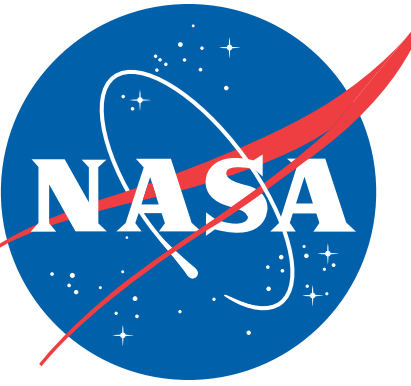
- Obtained observations for a small meteor from 2008 and backed out conditions
- Performed CFD simulations for both sphere and rock-like shapes w/ Cart3D using equilibrium air
- Propagate near-field pressure 74 km to observatory using sonic-boom propagation code
- Currently obtaining recorded ground signature from observatory for comparison



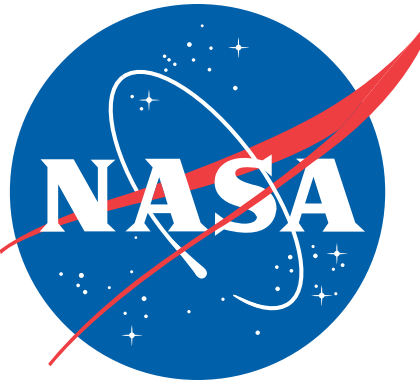
Airbursts: Flow-field Initialization



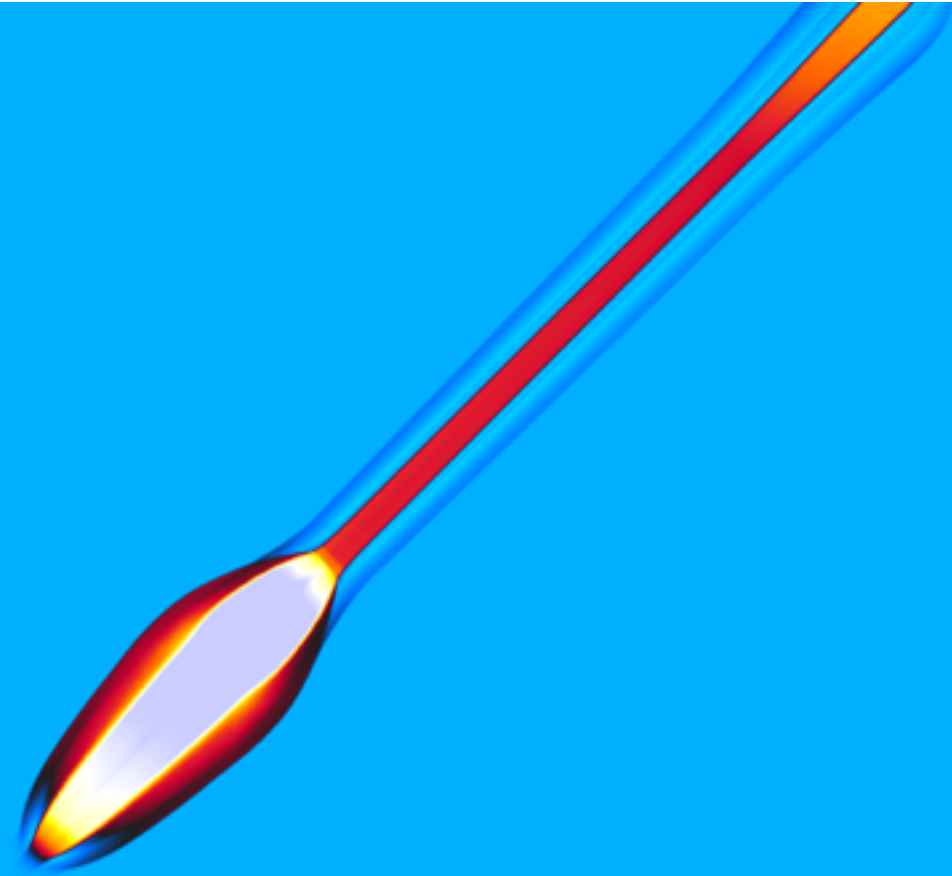
Mach Contours



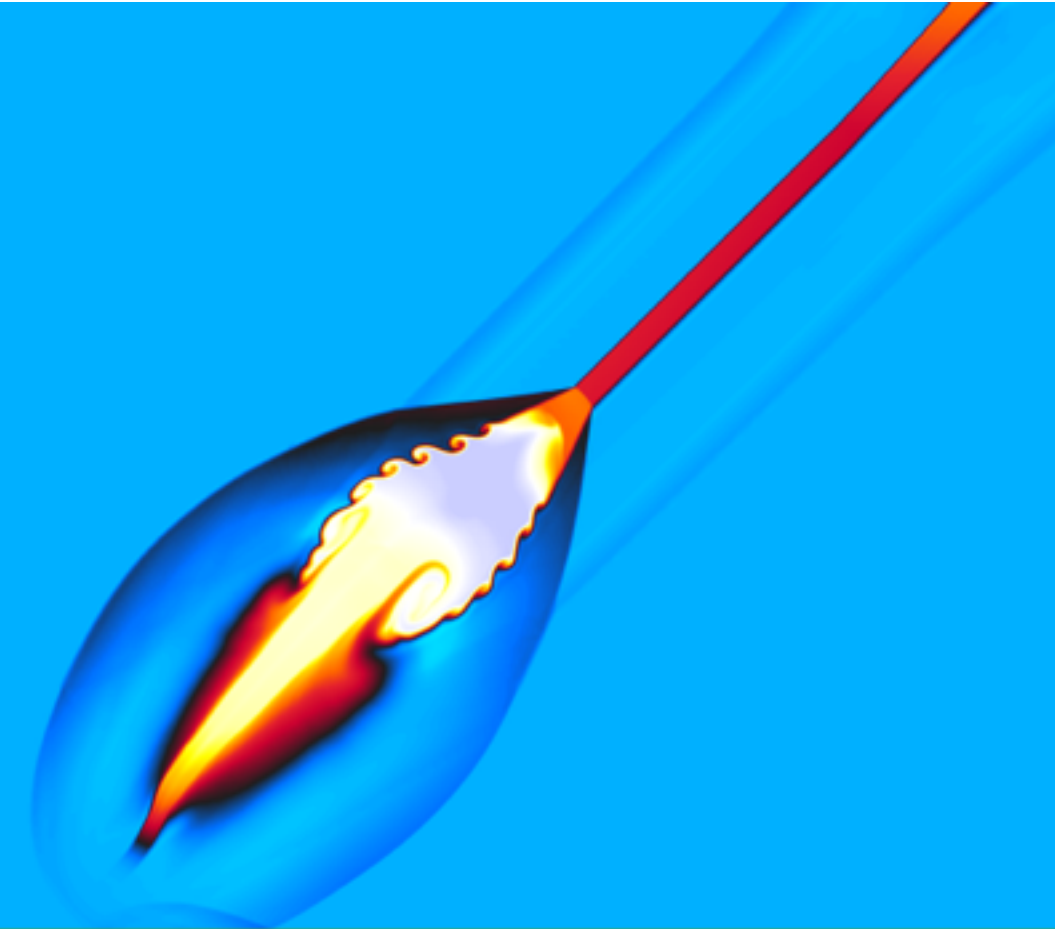
Temperature Contours



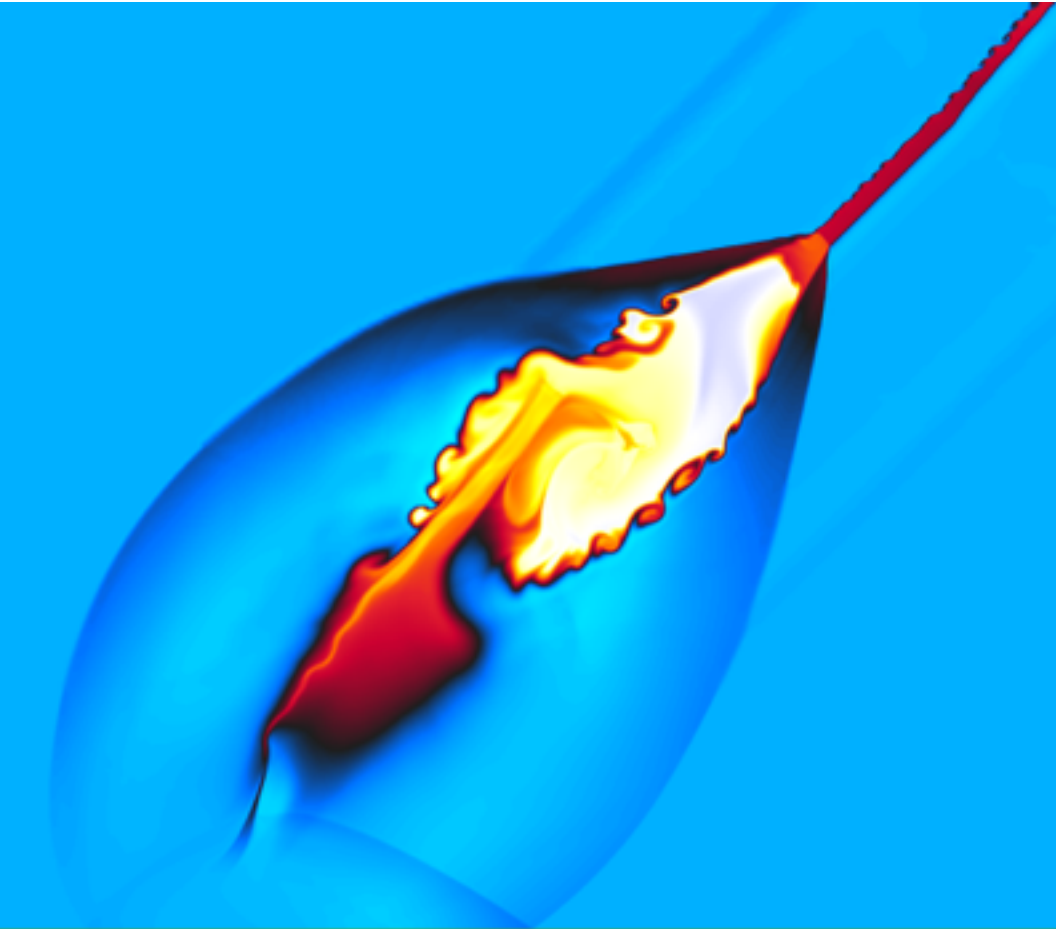
Temperature



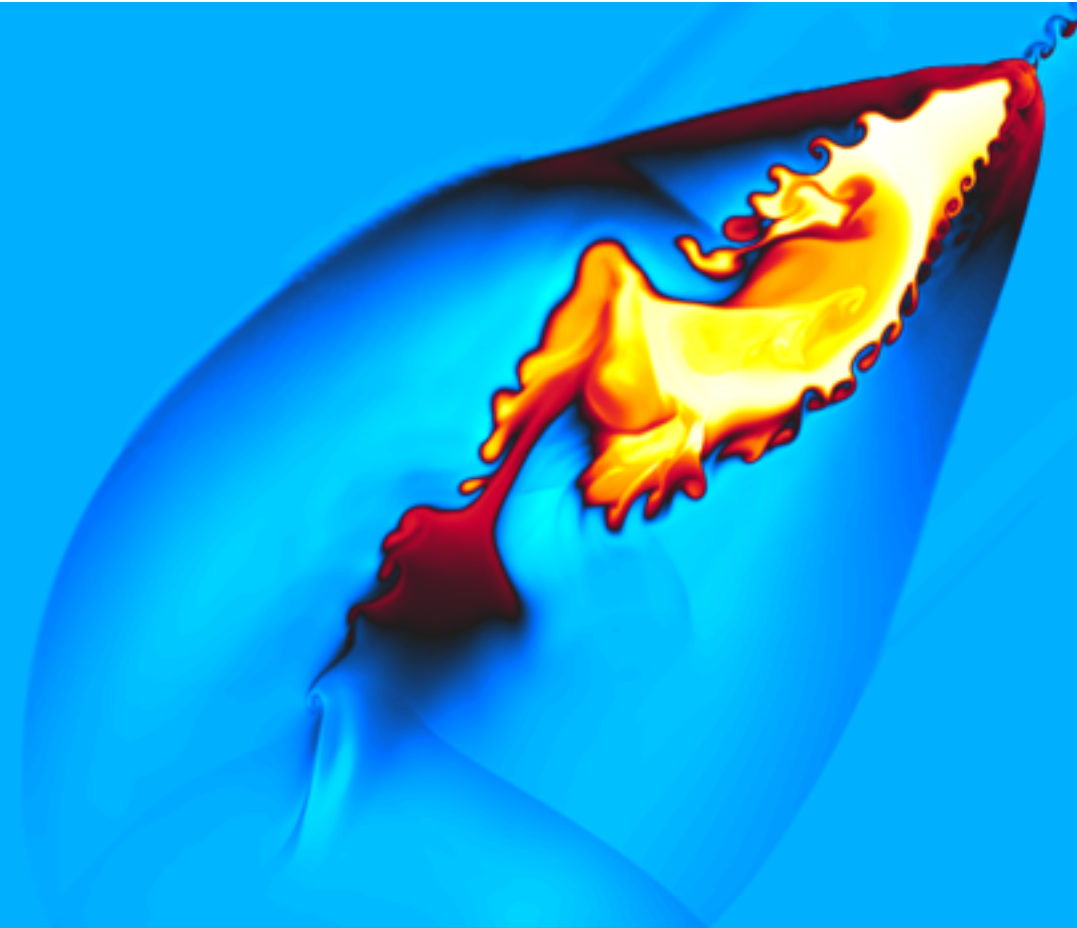
Temperature



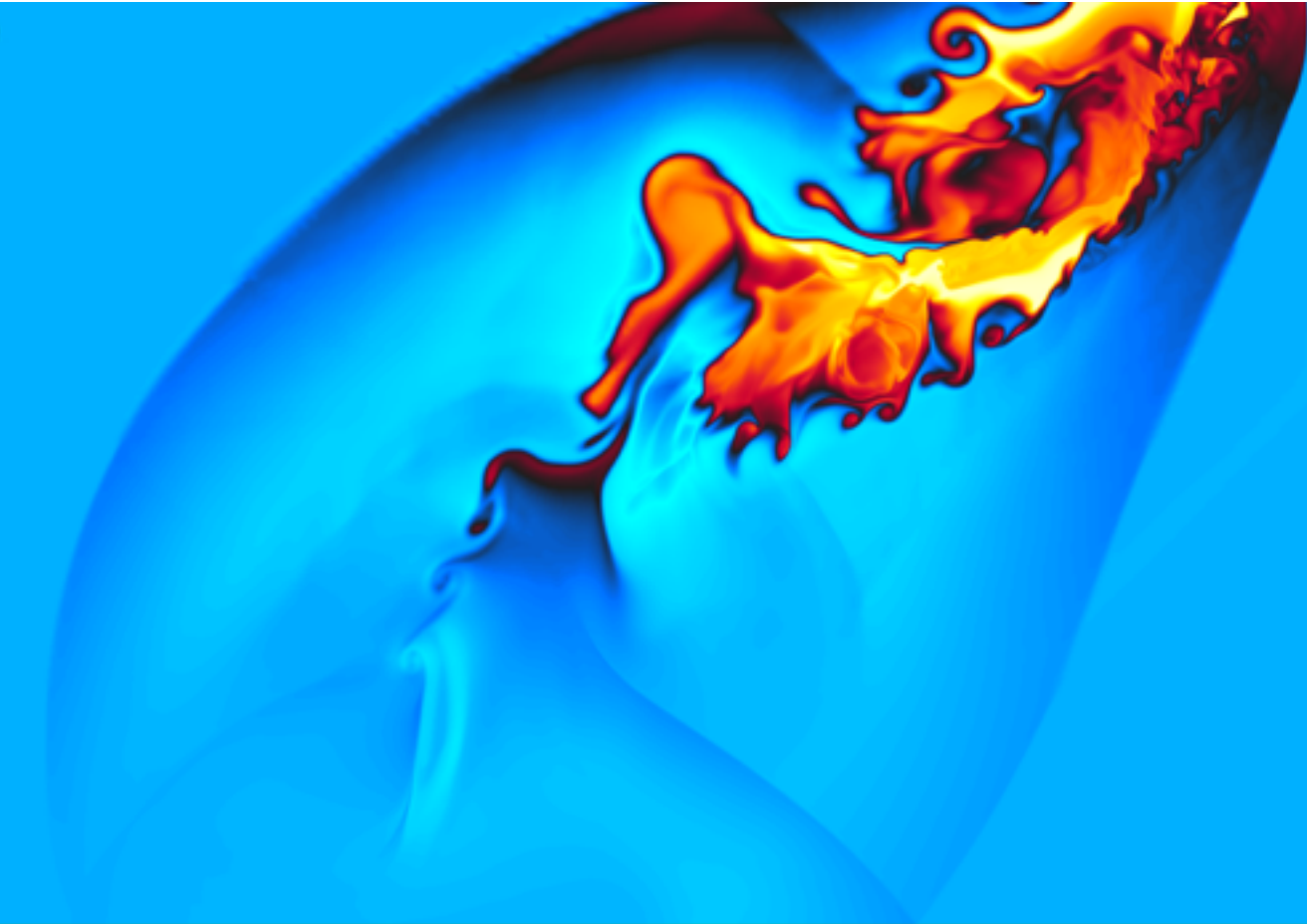
Temperature



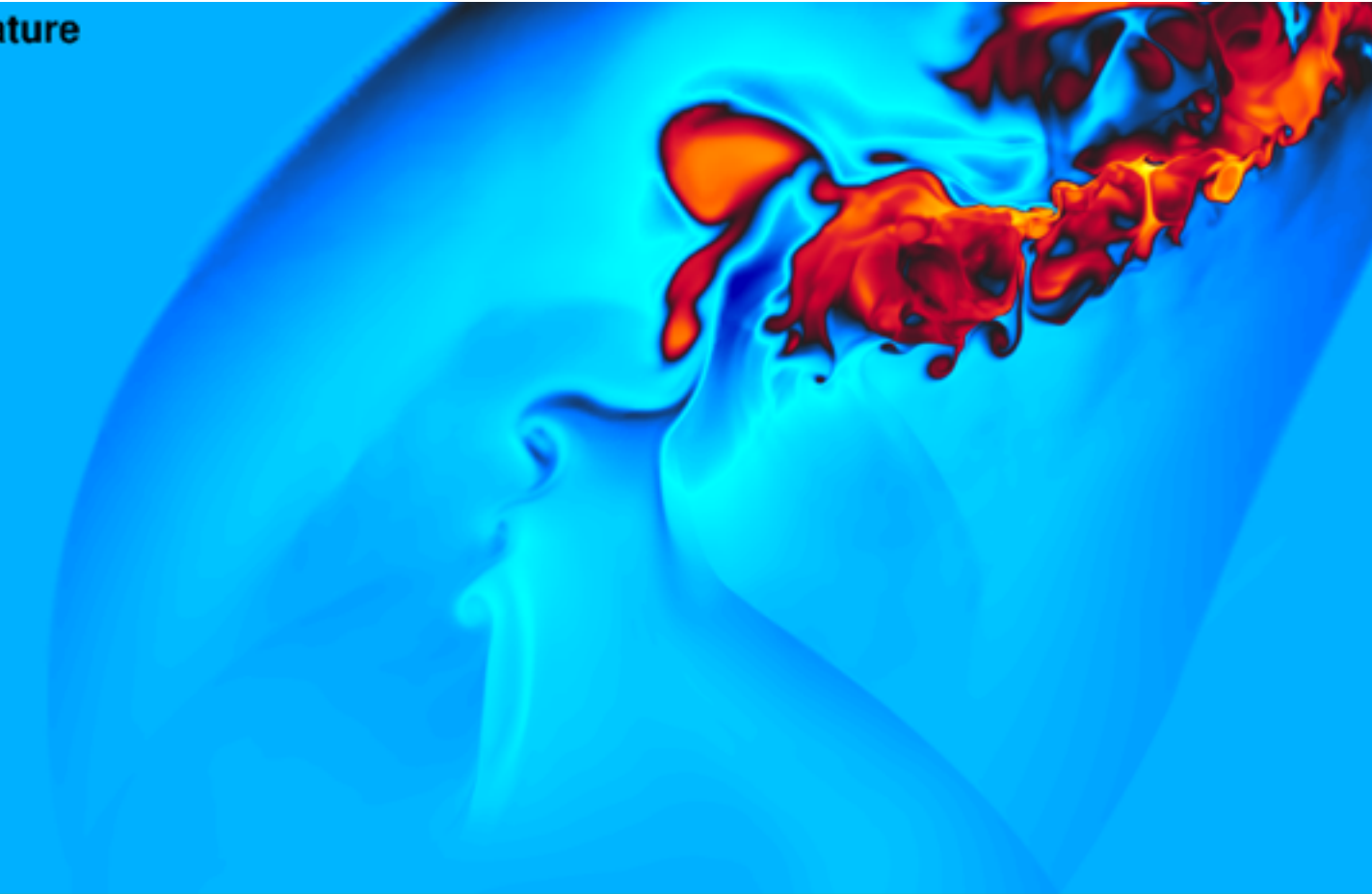
Temperature



Temperature

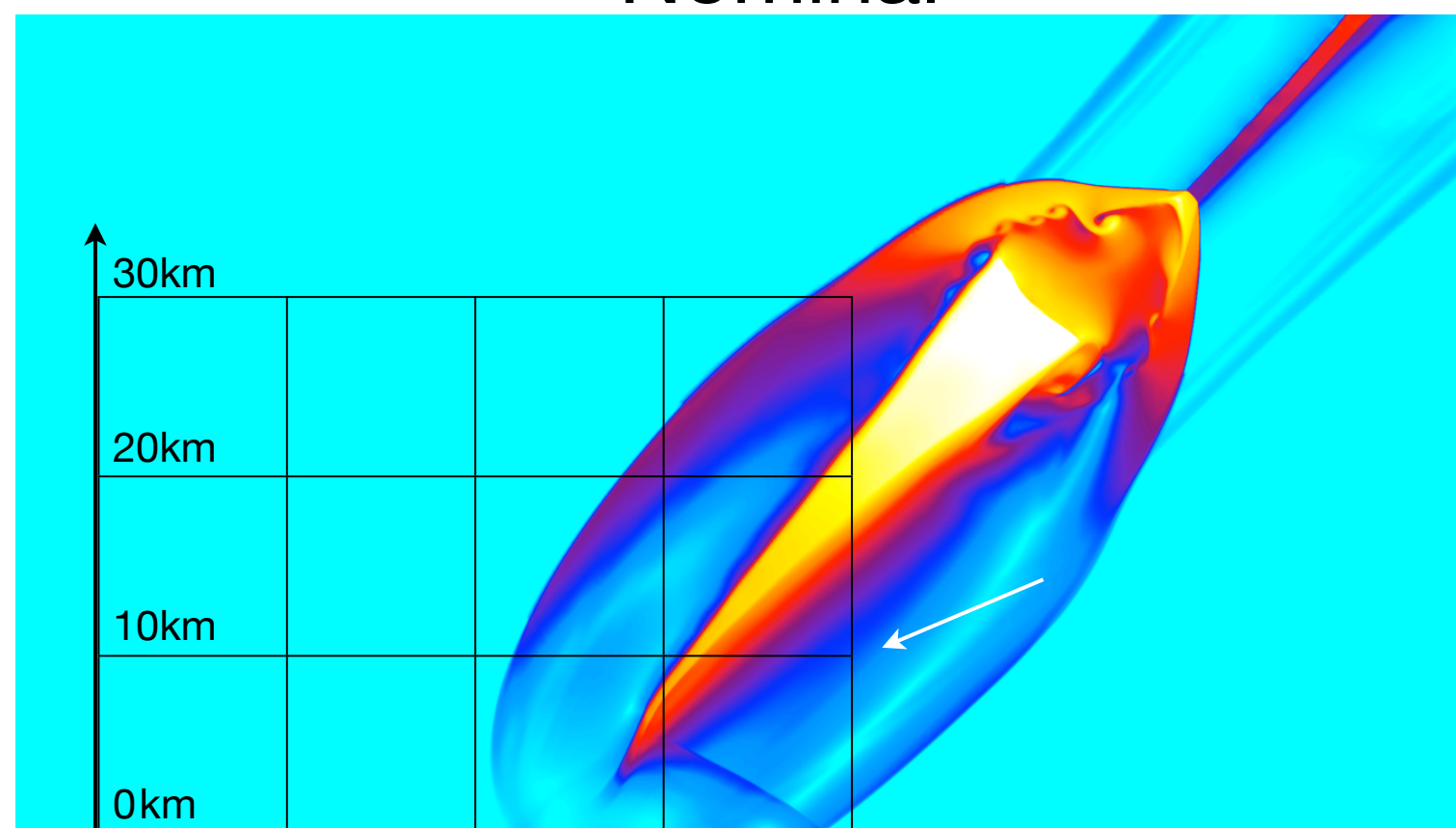


Temperature

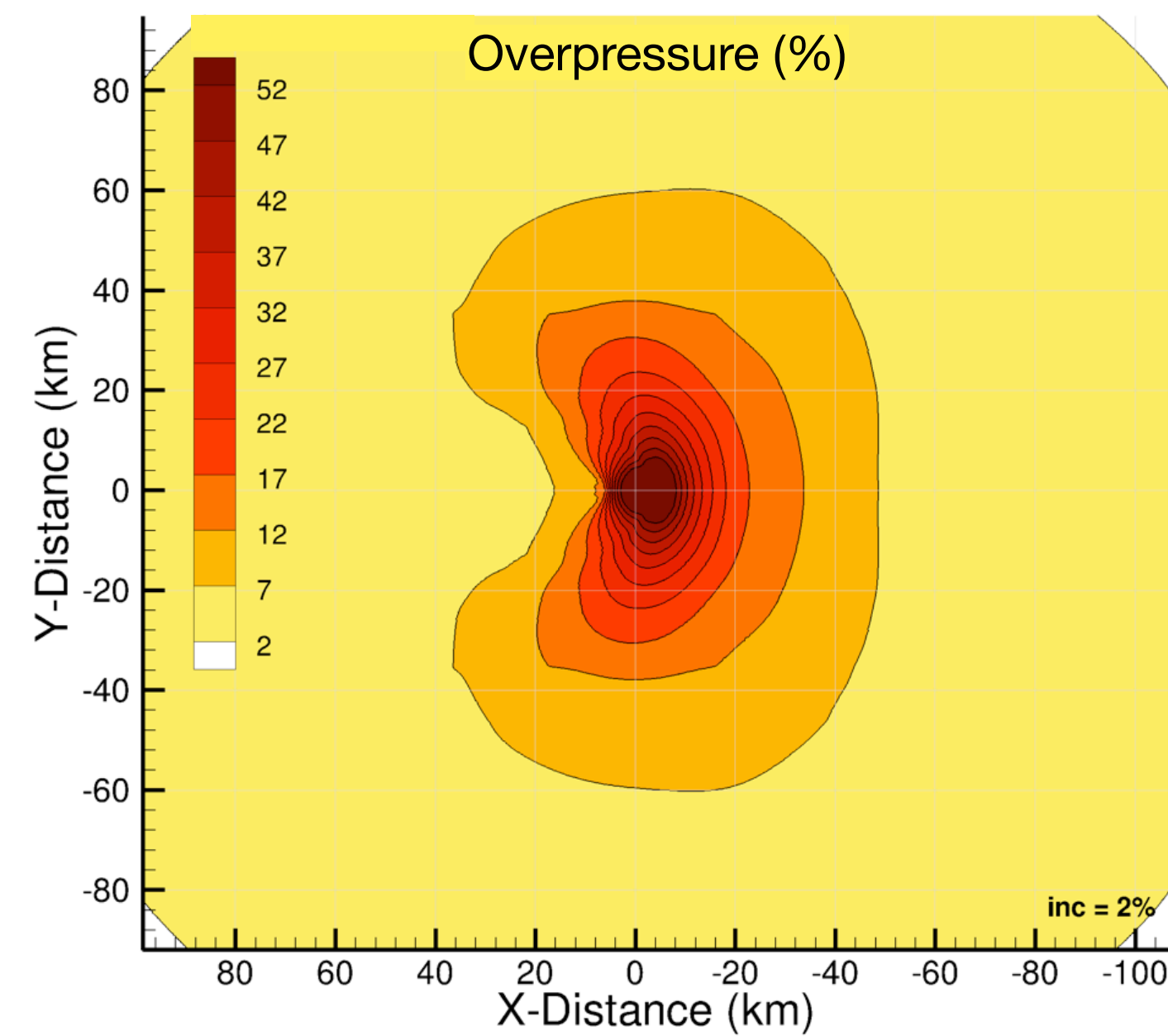
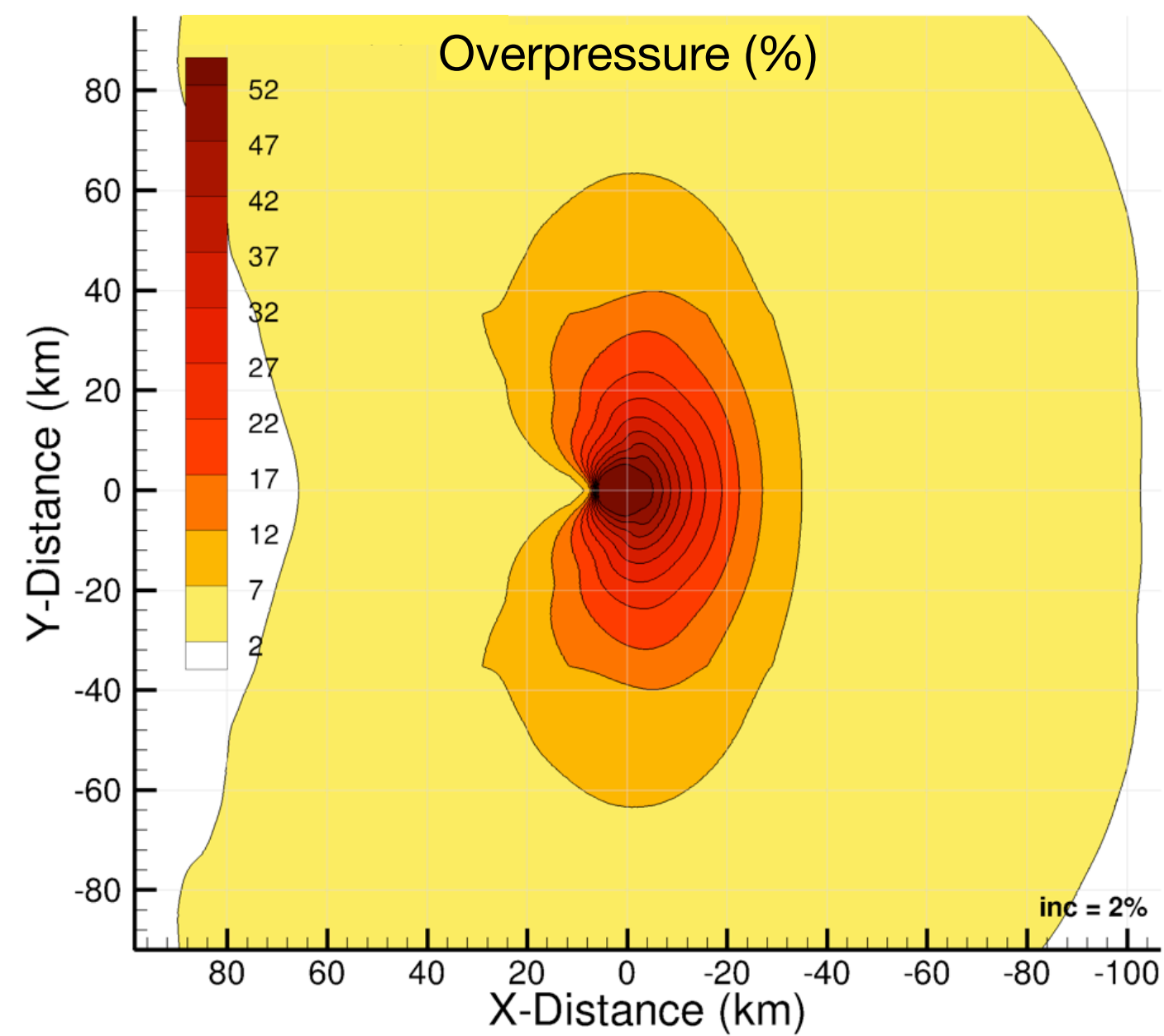
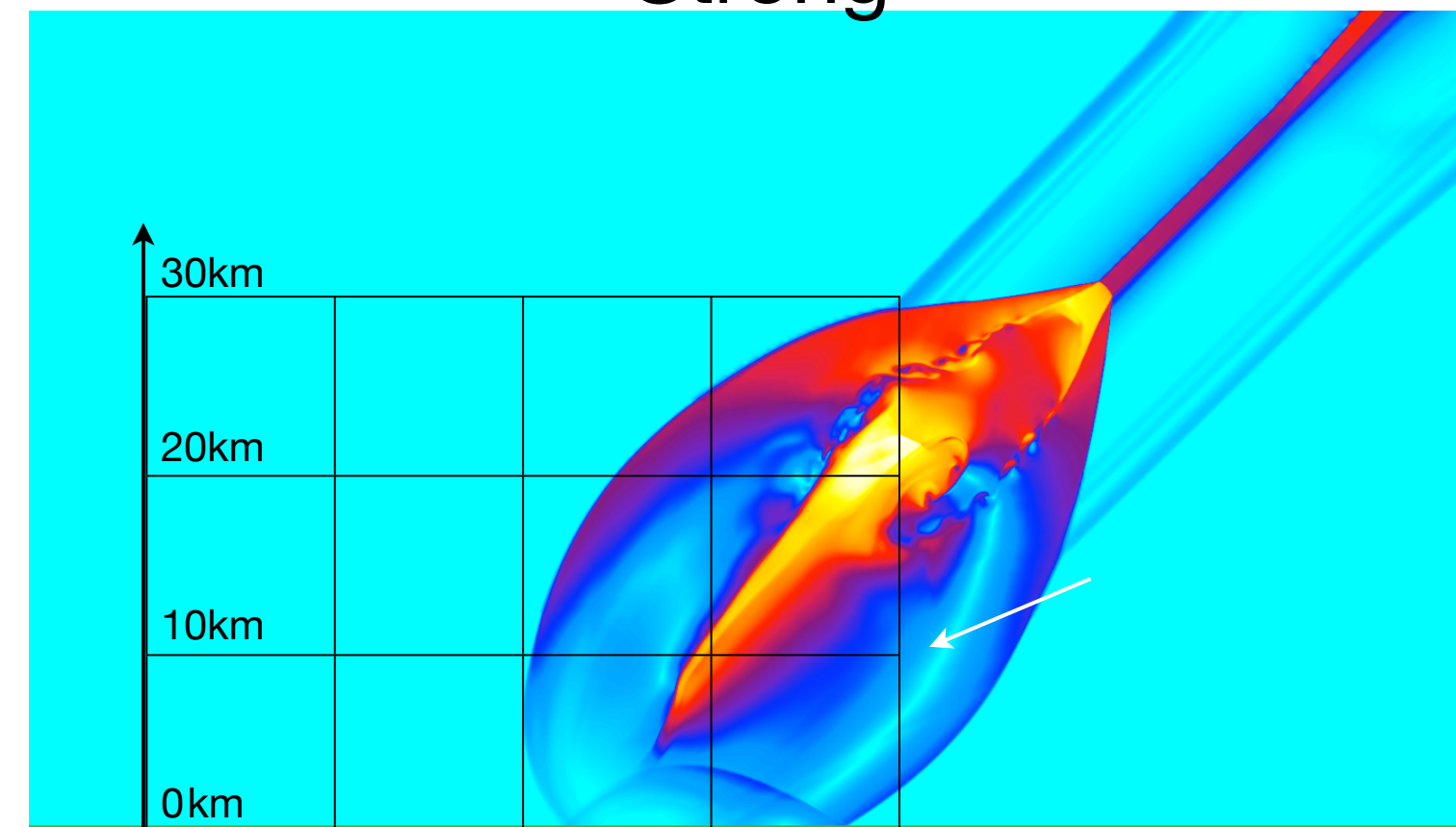


Ground Overpressure

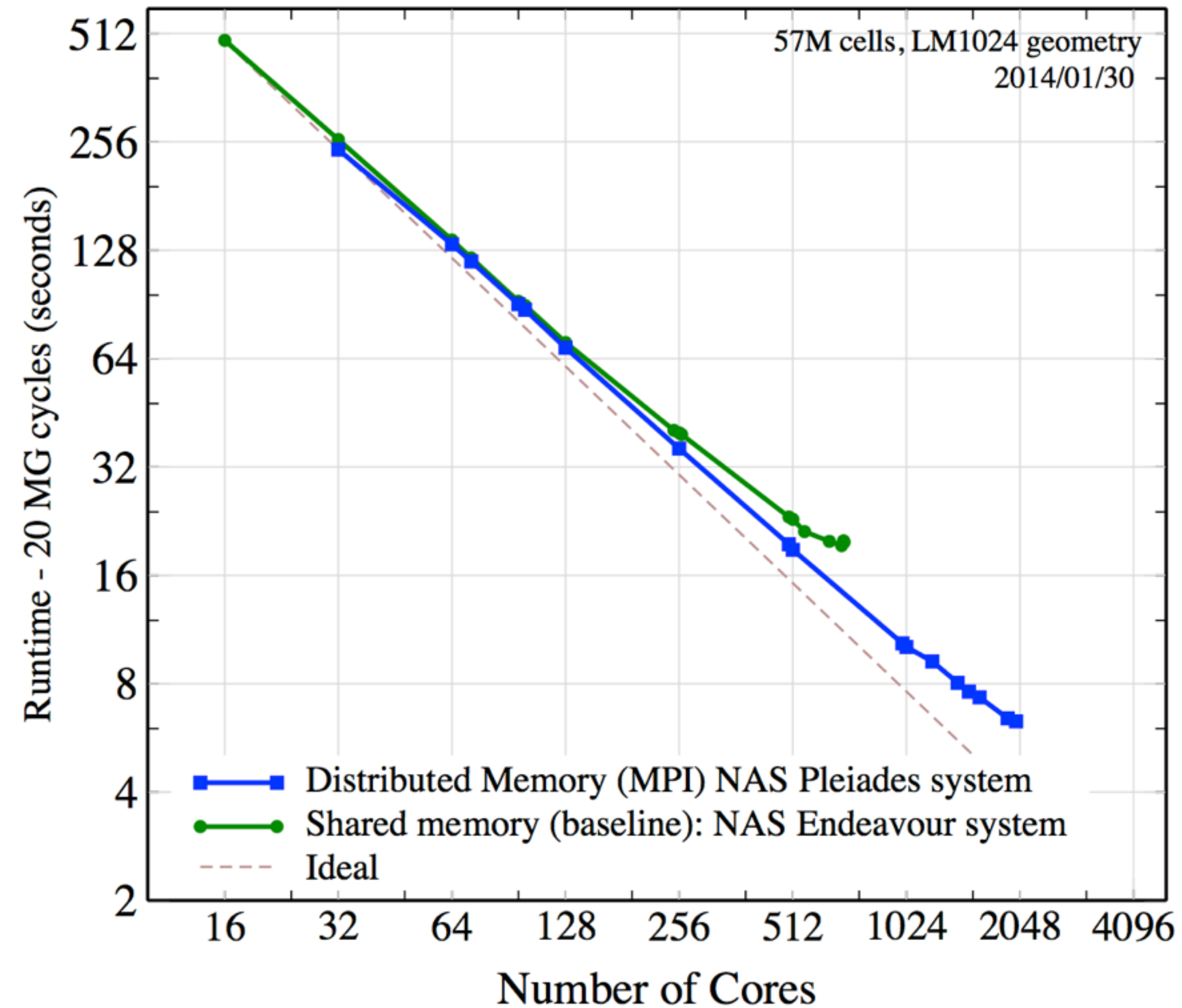
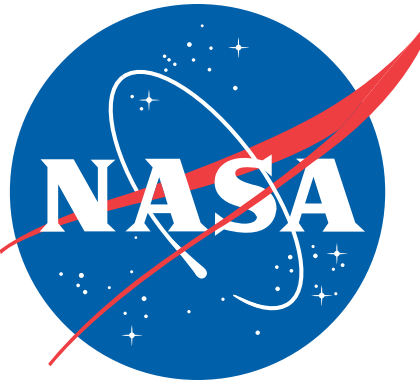
Nominal



“Strong”



HPC Performance



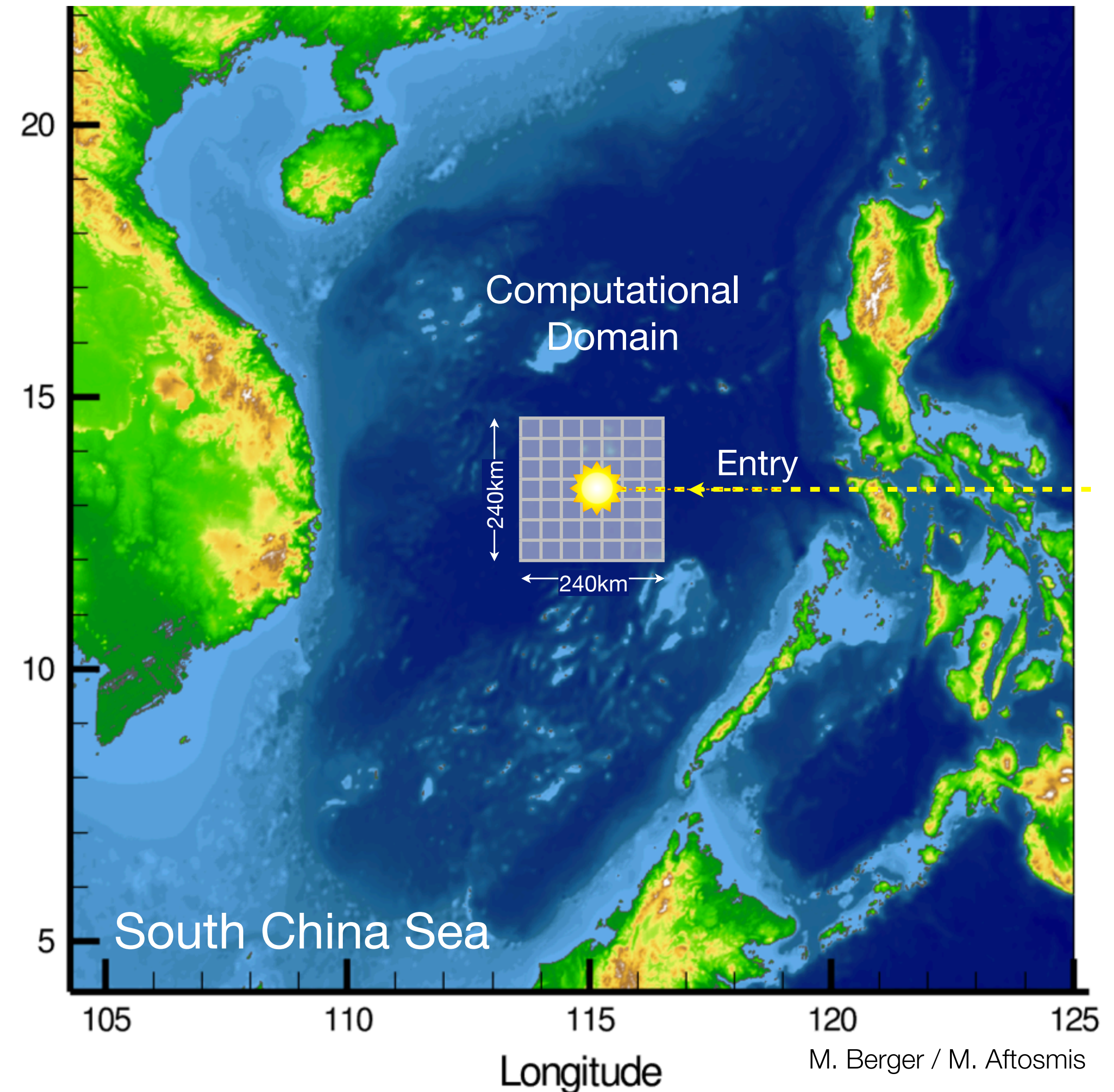
Tsunami Coupling



- Ground footprint evolution drives tsunami
- Coupled Cart3D surface pressure to GeoClaw package (U.Wash + NYU) for tsunami simulation

South China Sea, 200m diameter

- Domain Extent:
240 x 240 x 80 km high ~58,000 km² of surface
- ~105 M total cells
- 20 m resolution along trajectory,
- 80 m resolution at sea level
- 3D time-dependent simulations using Cart3D
- Resources
(1000 cores x ~12 hrs) on NAS Pleiades system



Tsunami

